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Novel methods to design permanent magnets for stellarators¹ CAOXIANG ZHU, MICHAEL ZARNSTORFF, DAVID GATES, STEVEN COW-LEY, Princeton Plasma Physics Laboratory — Excessively complex coil is one of the main challenges for stellarators. In recent years, tremendous efforts have been devoted to simplifying stellarator coils. These studies are all concentrating on currentcarrying electromagnet, which is the only type that has been used on stellarators to date. As the most common way to generate magnetic field, permanent magnet (PM) has the potential to extremely simplify stellarator coils. Here, we introduce two novel methods to design PM for stellarators. The first method takes a surface current potential solved by conventional coil design codes and discretizes magnetic dipoles to exactly recover the target magnetic field. By incrementally stacking multiple layers, the maximum magnetization could be constructed below the existing material limit. The second method nonlinearly optimizes the position, orientation and moment of each dipole to simultaneously minimize the magnetic field error and PM volume. It has the capability to find the most efficient arrangement for permanent magnets. By employing the two methods, we are able to design permanent magnets for stellarators. Numerical results of quasi-axisymmetric stellarators are shown.

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